

## Section 960

**GUIDELINES FOR SUPERPAVE VOLUMETRIC MIX DESIGN****960.01 Scope**

This procedure provides guidelines to determine a specific Superpave Volumetric Mix Design for Department projects. The Contractor will be responsible for performing all requirements for the mix design procedure and the Department will verify the mix design.

The Superpave Volumetric Mix Design Procedure is currently “Provisional” and is being further developed and evaluated before becoming a standard. Details for the Mix Design Procedure are included in the following documents that are incorporated into these Guidelines:

**AASHTO STANDARD:**

T-312	Standard Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor
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**AASHTO PROVISIONAL STANDARDS:**

PP28	Standard Practice for Superpave Volumetric Design for Hot Mix Asphalt (HMA)
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**ASPHALT INSTITUTE SUPERPAVE MIX DESIGN PROCEDURE:**

SP-2	Superpave Mix Design, Superpave Series No. 2 (SP-2)
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**UDOT METRIC STANDARD SPECIFICATIONS CSI FORMAT:**

Section 02741	HMA (Hot Mix Asphalt)
Section 02743	Hot Mix Asphalt - Small Projects/Bike and Pedestrian Paths
Section 02744	Hot Mix Asphalt - Procurement

**960.02 Process**

Guidelines for Superpave Volumetric Mix Design include requirements for pit source quality testing, aggregate crushing and stockpiles, selecting aggregate structure and trial blends, determining design asphalt binder content of mix, mix design report, mix design verification, mix design review report, mix design dispute resolution, and field volumetric mix design verification. Steps for completing each of these processes are described below.

## 960.03 Superpave Volumetric Mix Design Guidelines

### 960.03.01 Pit Source Quality Testing

Follow procedures outlined in Section 01455 of UDOT Standard Specifications for source of supply and quality requirements. Materials source quality tests will be verified prior to mix design verification and approval.

#### **The Following Tests May Be Verified By The Region Materials Lab:**

AASHTO T-89	Determining the Liquid Limit of Soils
AASHTO T-90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T-96	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
AASHTO T-104	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
AASHTO T-112	Clay Lumps and Friable Particles in Aggregates

### 960.03.02 Crushing and Stockpiles

Contractor will crush large enough stockpiles to be representative of pit production. Contractor shall have responsibility to establish and maintain a quality control plan or system that will provide assurance that materials produced conform to contract requirements. When a Quality Control Plan is required by contract, it shall govern QC activities. Otherwise, the contractor shall spell out an acceptable Quality Control Plan. Quality Control test results will be made available to UDOT for review and analysis. Production will be suspended when test results indicate materials do not conform to contract requirements. Resume production only when deficiencies are corrected.

#### **Tests Performed By The Contractor:**

AASHTO T-89	Determining the Liquid Limit of Soils
AASHTO T-90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO T-27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T-19	Unit Weight and Voids in Aggregate
AASHTO T-11	Materials Finer Than No. 200 Sieve in Mineral Aggregates by Washing
AASHTO T-304	Fine Aggregate Angularity
AASHTO T-176	Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test (Alternate Method No. 2 - Pre-Wet)
ASTM D-4791	Flat and Elongated (3:1 Ratio) - Based on 3/4 inch and above
ASTM D-5821	Fracture Face (One Fracture)
ASTM D-5821	Fracture Face (Two Fracture)
AASHTO T-84	Specific Gravity and Absorption of Fine Aggregate*
AASHTO T-85	Specific Gravity and Absorption of Coarse Aggregate*

\*Note - Specific gravities are required on all separate stockpiles. It may be advisable that tests be performed on any sieve size that has 10% or more retained for mix design accuracy.

**960.03.03 Aggregate Structure Design and Trial Blends**

To select the design aggregate structure, trial blends are established by mathematically combining the gradations and proportions of individual aggregates or stockpiles. Gradations of each stockpile must be fractionalized to each sieve size and then each individual sample blended accurately to target values that meet required specification controls. Include lime as a separate stockpile with its own specific gravity. Plant adjustments in gradation must be accounted for. A minimum of three blend gradation variations are evaluated by compacting specimens from each blend at an estimated asphalt binder content to determine volumetric properties of each trial blend. After evaluating volumetric properties of all trial blends, select one blend with its estimated asphalt binder content that meets all of the project specifications. The following tests and procedures provide details for determining the trial blend aggregate structure design with its estimated asphalt binder content:

**Aggregate Structure Design And Trial Blends Performed By The Contractor:**

Asphalt Institute SP-2, Superpave Mix Design

AASHTO PP28, Standard Practice for Designing SUPERPAVE HMA

AASHTO TP4, Standard Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor

AASHTO T-209, Maximum Specific Gravities of Bituminous Paving Mixtures

The asphalt binder used in the design shall be obtained from a certified supplier meeting the requirements outlined in UDOT Manual of Instruction, 209. The binder shall be accompanied by test results or pretested by the Central Materials Asphalt Laboratory prior to use in the design. Mixing and compaction temperatures for the mix design must be obtained from the Region Materials Engineer. Mix design results appear to be very sensitive to mixing temperatures. It is recommended that mixing and compaction temperatures be closely controlled.

**960.03.04 Asphalt Binder Content Design**

Once the design aggregate structure (trial blend) is selected with its estimated asphalt binder content, then specimens are compacted at varying asphalt binder contents and evaluated to determine the design asphalt binder content. The following tests and procedures provide details for determining the asphalt binder content for the mix design:

**Asphalt Binder Content Design Performed By The Contractor:**

AASHTO TP4, Standard Method for Preparing and Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the Superpave Gyratory Compactor Asphalt Institute

SP-2, Superpave Mix Design

AASHTO T-209, Maximum Specific Gravities of Bituminous Paving Mixtures

AASHTO T-283, Modified by UDOT Manual of Instruction, 957, Modified Lottman

UDOT Manual of Instruction, 958, Standard Test Method for Determining Rutting Susceptibility Using the Asphalt Pavement Analyzer

After the design is completed, the contractor will run 4 sets of 2 Gyratory specimens, as spelled out in UDOT specifications, to verify the optimum asphalt binder content and all other design requirements. If the air void content at  $N_{\text{design}}$  varies from four percent, a corrected design asphalt binder content to achieve 4 percent air voids at  $N_{\text{design}}$  is determined, and the corrected design properties at this corrected design asphalt binder content are calculated. See SP-2, pages 60-61 for correction equations.

### **960.03.05 Contractor's Mix Design Report**

The contractor shall complete and submit a mix design report that will include all test data from all tests performed by the contractor during the design process.

The mix design report shall contain all of the information outlined in Appendix "A", with a summary format in the first two to three pages. The Mix Design Report shall be submitted to the Region Materials Engineer and a Mix Design Report summary and transmittal letter to the Project Engineer before verification can proceed. The mix design report shall follow the outline and example in Appendix "A".

Notify UDOT personnel a minimum of three working days before the Contractor's design process begins. UDOT personnel may request to observe the process.

### **960.03.06 UDOT's Mix Design Verification**

#### **General:**

The mix design verification process outlined in this document is intended to be complete. However, verification could include any or all tests identified in Asphalt Institute's SP-2, project specific paving specifications, project specific special provisions, the current UDOT Manual of Instruction Part 8, the current UDOT Minimum Sampling and Testing Requirements or other aggregate quality, volumetric, or mix performance tests that may have been missed or will be added in the future. The mix design shall meet all specification requirements referenced above.

Specifications identify the period of time allotted for a mix design verification in terms of "working days". "Working days" refer to Monday through Friday and they begin when the following criteria have been met:

- C     *All aggregate quality and other verification test results have been submitted.*
- C     *All aggregate samples for quality verification tests (one bag, 50 - 80 lb, of aggregate from each stockpile used) have been submitted.*
- C     *All pre-blended samples have been submitted . A pre-blended sample is a final blend of the aggregate structure to be used minus the lime and asphalt binder. The lime and asphalt binder shall be submitted separately so that they can be*

- individually introduced during the verification process.
- C A *sufficient quantity* of the correct asphalt binder (exact asphalt binder used by Contractors's consultant lab) has been supplied to the Region Laboratory for the verification process.
- C A *sufficient quantity* of the correct lime (same line used by Contractor's Consultant lab) has been supplied to the Region Laboratory for the verification process.

"Working days" end when the Region Materials Engineer provides an answer of "Verified as submitted", "Verified with conditions," or "Not Verified for the following reasons."

Verification of testing results by the Region can be achieved either through proper testing procedures or by source history.

A mix design achieving verification in any one Region may be submitted for verification in another Region. Submit requests through the Materials and Project Engineers of the targeted Region.

#### **Recommended Testing Precision Criteria:**

The following testing precision criteria are recommended as a guide and should be used as a tool to improve the verification process:

Testing Subject	Precision
T-84 - Specific Gravity and Absorption of Fine Aggregate	±0.027
T-85 - Specific Gravity and Absorption of Coarse Aggregate	±0.020
T-166 - Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens	±0.020
T-209 - Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures	±0.012
Gyratory Specimen Heights for Design (Average)	±0.2 inches
Gyratory Specimen Heights for UDOT Verification (Average)	±0.1 inches

#### **Mix Design Verification Criteria:**

**Air Voids:** Air voids in the mix shall be the final verification criterion. The calculated air voids at  $N_{\text{design}}$  must fall between 3.2% and 4.5%. If specification requirements or  $N_{\text{design}}$  air voids criteria are not met, the verification process will stop until discrepancies have been resolved. When the verification process stops for these reasons, the time allotted by specification for mix design verification will be suspended and will not begin again until the discrepancy has been resolved. At no time will the Materials Engineer allow UDOT's testing results to be used in any of the submitting entity's volumetric calculations.

**Aggregate Quality Tests:** The required aggregate quality tests performed by the contractor shall be reviewed and verified that they meet specification minimum criteria. Any or all quality tests may or may not be verified by UDOT Region Laboratory. Contractor shall submit one bag, 50 - 80 lb, of aggregate from each stockpile or fraction

used for verification testing.

Aggregate Properties - Hot Mix Asphalt			
Test Method	Test No.	Category 1	Category 2
One Fractured Face	ASTM D-5821	95% min.	85% min. (1 and 3/4 inch) and 90% min (1/2 and 3/8 inch)
Two Fractured Face	ASTM D-5821	90% min.	80% min. (1 and 3/4 inch) and 90% min. (1/2 and 3/8 inch)
Fine Aggregate Angularity	AASHTO T-304	45 min.	45 min.
Flat and Elongated 1 to 3 ratio	ASTMD-4791 (Based on 3/8 inch and above)	20% max.	20% max.
L.A. Wear	AASHTOT-96	35% max.	40% max.
Sand Equivalent	AASHTOT-176 (Pre-wet method)	60 min.	45 min.
Plasticity Index	AASHTO T-89, T-90	0	0
Unit Weight	AASHTO T-19	min. 75 lb/ft <sup>3</sup>	min. 75 lb/ft <sup>3</sup>
Soundness (sodium sulfate)	AASHTO T-104	16% max. loss with five cycles	16% max. loss with five cycles
Clay Lumps and Friable Particles	AASHTO T-112	2% max	2% max
Natural Fines	N/A	0	10% max.
Category 1: National Highway System and Truck Routes Category 2: All Other Routes			

Any or all of the above quality verification tests may be revisited during production. If any of the aggregate quality tests do not meet the specified minimum criteria, production shall be halted and the problem corrected.

**Asphalt Binder:** The selected asphalt binder shall meet specified project requirements.

**Design Gyration:** The design gyrations selected for  $N_{initial}$ ,  $N_{design}$  and  $N_{maximum}$  shall meet specified project requirements.

<p>Number of Gyration Table Determined by Specification or Region Materials Engineer</p>
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20 Years Design ESALs* (Million)	Compaction Parameters			Void Filled with Asphalt (VFA) (%)
	$N_{\text{initial}}/\%$ of $G_{\text{mm}}^*$	$N_{\text{design}}/\%$ of $G_{\text{mm}}^*$	$N_{\text{max}}/\%$ of $G_{\text{mm}}^*$	
0.3	6/#91.5	50/96	75/#98	70-80***
0.3 to <3	7/#90.5	75/96	115/#98	65-78
3 to < 30	8/#89	100/96	160/#98	65-75
\$30	9/#89	125/96	205/#98	65-75

\*  $G_{\text{mm}}$  = Maximum Specific Gravity of Mix (Rice)

\*\* 20 years Design ESALs as defined in the plan summary sheets

\*\*\* 67% specified lower limit VFA for 1 inch nominal maximum size mixture.

### Gradation:

- C The gradation will be analyzed and verified that it falls within selected gradation control points. Report percent passing for each required Superpave sieve.
- C The gradation will be a true nominal size mix (<90%, but not equal to 90%, passing the nominal screen and also 100% of the material passing the sieve above the nominal maximum size screen).
- C The actual stockpile gradations and blending percentages must be submitted and may be verified by the Region and compared to the submitted data. If the stockpile blending percentages are incorrect, the volumetric properties may be affected because of the incorrect apportioning of individual stockpile specific gravities.

Aggregate Gradations  
(Percent Passing by Dry Weight of Aggregate)

Sieve Size (inch)		1 Nominal Size	3/4 Nominal Size	1/2 Nominal Size	3/8 Nominal Size
Control Sieves (Mix Design)	<b>1 1/2</b>	100.0	-	-	-
	<b>1</b>	90.0 - 100.0	100.0	-	-
	<b>3/4</b>	<90	90.0 - 100.0	100.0	-
	<b>1/2</b>	-	<90	90.0 - 100.0	100.0
	<b>3/8</b>	-	-	< 90	90.0 - 100.0
	<b>No. 4</b>	-	-	-	< 90
	<b>No. 8</b>	19.0 - 45.0	23.0 - 49.0	28.0 - 58.0	32.0 - 67.0
	<b>No. 200</b>	1.0 - 7.0	2.0 - 8.0	2.0 - 10.0	2.0 - 10.0
Caution Zone Boundaries (Information only)	<b>No. 4</b>	39.5	-	-	-
	<b>No. 8</b>	26.8-30.8	34.6	39.1	47.2
	<b>No. 16</b>	18.1-24.1	22.3-28.3	25.6-31.6	31.6 - 37.6
	<b>No. 30</b>	13.6-17.6	16.7-20.7	19.1-23.1	23.5 - 27.5
	<b>No. 50</b>	11.4	13.7	15.5	18.7

### Pre-Blended Samples to be Supplied by the Contractor:

UDOT's Verification results will be determined from tests of pre-blended samples prepared and submitted by the Contractor. These samples shall be individual pre-blended samples and shall be submitted to the Region Materials Engineer for verification. A pre-blended sample is a final blend of the aggregate structure to be used, minus the lime and asphalt. The lime and asphalt shall be submitted separately so that they can be individually introduced during the verification process. Samples will be made by the contractor by recombining each individual sieve size from the proper material blend to meet the target gradation and proper sample size. It is not acceptable to create one large sample and split it down to smaller samples, adding material to the smaller split samples to compensate sample size. Lime shall be considered as a separate stockpile with its own specific gravity. If the gradation precision of submitted samples is determined to be unacceptable by the Region Materials Engineer, new samples shall be submitted by the contractor and the verification process shall restart. The gradation will be determined after UDOT mixes Contractor's individual pre-blended aggregate samples with lime as per specification. The aggregates will be graded and the results obtained compared to the target gradation.

The following tolerances from target gradation for each sieve will be allowed:

1/2 inch       $\pm 2\%$



3/8 inch	± 2%
No. 4	± 2%
No. 8	± 1%
No. 16	± 1%
No. 30	± 1%
No. 50	± 1%
No. 80	± 1%
No. 200	± 0.8%

**Samples Submitted by The Contractor:****Gyratory Compaction Samples - 9 Samples**

\*\*All specimens will be short termed aged at compaction temperature for 2 hours unless aggregate absorption is greater than 2.5%. For high absorption aggregate (>2.5%), short term age for 4 hours.

- C 4 sets of 2 samples will be used for the gyratory.
- C 1 sample will be for Department use.

**AASHTO T-209 - 4 Samples**

- C These samples will be used for determination of maximum theoretical specific gravity.

**Ignition Oven Calibrations - 10 Samples**

- C These samples will be used for Region and Project ignition oven calibrations and will be submitted after mix design verification has been completed and prior to project production. The contractor shall submit 10 cold feed aggregate samples, split to appropriate size, along with sufficient asphalt binder from the project production tank.

**VFA** - The submitted VFA shall meet minimum/maximum specification requirements.

VFA Table	
20 Years Design ESALs** (Million)	Voids Filled with Asphalt (VFA) (%)
0.3	70-80***
0.3 to <3	65-78
3 to < 30	65-75
\$30	65-75

\*  $G_{mm}$  = Maximum Specific Gravity of Mix (Rice)

\*\* 20 years Design ESALs as defined in the plan summary sheets

\*\*\* 67% specified lower limit VFA for 1 inch nominal maximum size mixture.

**VMA** - The submitted VMA (Calculated as Percent by Weight of Total Mix) shall meet minimum/maximum specification requirements.

Voids in Mineral Aggregate (VMA) at $N_{design}$	12.0% -14.0% for 1 inch
	13.0% -15.0% for 3/4 inch
	14.0% -16.0% for 1/2 inch
	15.0% - 17.0% for 3/8 inch

**Dust Proportion** - The Dust Proportion tolerance shall be 0.6 to 1.6.

**AASHTO T-283 (Modified), UDOT 957** - The submitted Lottman Test, AASHTO T-283 (Modified) shall meet the minimum specification requirements of 80% retained strength.

**Hydrated Lime** - The submitted lime percentage shall meet specification and design requirements. Initial plant inspection will be performed to verify lime slurry capabilities. The added lime shall be verified to be included as part of the aggregate structure in all calculations.

**Asphalt Pavement Analyzer**- The Asphalt Pavement Analyzer (Rut Test) shall be run according to UDOT Manual of Instruction 958 and shall meet specification requirements.

Pavement Analyzer (Rut test at high temperature of UDOT PG Asphalt Map)	< 0.2 inches
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**Gyratory Specimen Heights** - The submitted Gyratory Specimen Heights shall fall within Superpave guidelines of 4.5 in  $\pm$  0.2 in for design and recommended UDOT

guidelines of 4.5 in  $\pm$  0.10 in for verification.

**AASHTO T-84 & T-85, (SSD method)** - (Mandatory Dispute Resolution Test) The fine and coarse aggregate specific gravities and absorptions, AASHTO T-84 & T-85 (SSD method) will be evaluated and verified. They should fall within the acceptable testing precision as previously defined.

**AASHTO T-209** - (Mandatory Dispute Resolution Test) The maximum specific gravity of loose paving material, AASHTO T-209, shall be verified. It should fall within the acceptable testing precision as previously defined.

**AASHTO T-166** - (Mandatory Dispute Resolution Test) The bulk specific gravity of the compacted mix, AASHTO T-166, shall be verified. It should fall within the acceptable testing precision as previously defined.

**Air Voids** - The target 4.0 % air voids shall be verified at  $N_{\text{design}}$ . The calculated results must fall between 3.2 and 4.5 percent air voids.

### 960.03.07 UDOT's Mix Design Review Report

After reviewing the mix design report and performing verification testing, the Region Materials Engineer will submit a written summary report to the Project Engineer as notification of verification results. This Mix Design Review Report will state the verification results as either "Verified as submitted", "Verified with the following conditions," or "Not Verified for the following reasons." and will contain a summary of verification test results and needed construction information. Appendix "B" shows an example of information contained in the Mix Design Review Report. Verification of the mix design may only be given by the Region Materials Engineer.

### 960.03.08 Volumetric Mix Design Dispute Resolution

**"Mandatory Dispute Resolution Test":** This document refers to certain test procedures as a "Mandatory Dispute Resolution Test." If a mix design does not achieve verification through the Region laboratory, all mandatory tests identified are to be performed, compared and used in the "dispute resolution" process. These tests, as well as their results, are the focal point to resolve any discrepancies between the Region and Consultant laboratories. If the above procedures are followed and the recommended testing precision has been achieved, the mix design should verify. If the mix design does not verify after verification testing has been completed, the focus of the volumetric mix design resolution will be on the volumetric mix properties, the appropriate calculations and relationships to the following tests:

- C     **AASHTO T-209** - Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
- C     **AASHTO T-166** - Bulk Specific Gravity of Compacted Bituminous Mixtures using Saturated Surface-Dry Specimens

- **AASHTO T-84 & T-85, (*SSD method*)** - The fine and coarse aggregate specific gravities and absorptions, AASHTO T-84 & T-85 (SSD method).

The testing precision will be analyzed and the tests may be re-run by both parties involved.

#### **960.03.9 Field Volumetric Mix Design Verification**

If testing discrepancies and volumetric resolutions cannot be achieved with the above process, it is recommended that the Region Materials Engineer go to a field volumetric mix design verification. The Contractor will produce a minimal amount of mix from the project specific plant. A sufficient quantity of mix will be produced to establish proper quality control. Samples will be properly taken and tested by UDOT and the Contractor prior to project production. This material will not be placed on the project unless approval to do so is obtained from the Region Materials Engineer. The volumetric properties of this field produced mix will be analyzed and evaluated according to the established mix design verification process.

**APPENDIX “A”**

**INFORMATION OUTLINE FOR CONSULTANT / CONTRACTOR**  
**MIX DESIGN REPORT**

**First Two/Three Pages of Design Submitted Shall Include the Following Mix Design Information:**

- C Date:
- C Laboratory Name:
  - Accreditation / Credentials (AMRL/UDOT approved)
- C Laboratory Technicians :
  - Credentials (NICET/UDOT certified)
- C UDOT Project Name & Number:
- C Nominal Gradation Size:
- C Number of Gyration:
  - Nini, Ndes, Nmax
  - Corresponding ESAL Loading Range
- C Gyratory Compactor:
  - Brand / Model
- C Asphalt Binder:
  - PG Grade
  - Binder Source
  - Binder Specific Gravity
- C Measured Physical Properties
  - Design Mixing Temperature
  - Design Compaction Temperature
  - % Asphalt Binder Content @ Ndes
  - % Absorbed Asphalt Binder @ Ndes
  - % Effective Asphalt Binder @ Ndes
  - % VMA @ Ndes (Percent by Weight of Total Mix)
  - % VFA @ Ndes
  - % Compaction @ Nini
  - % Compaction @ Ndes
  - % Compaction @ Nmax
  - Dust to Asphalt Binder Ratio @ Ndes
  - Maximum Specific Gravity @ Ndes
  - % Lime Required
  - Bulk Specific Gravity
  - Maximum Specific Gravity
  - Target Gradation
- C Proof Testing - (Specification Dependent)
  - Lottman
  - Pavement Analyzer (Rut Tester)
- C Aggregate
  - One Fracture Face Count
  - Two Fracture Face Count
  - Fine Aggregate Angularity

Flats & Elongates  
L.A. Wear  
Sand Equivalency (SSD Method)  
Natural Fines %



C Additional Aggregate Source Information  
Sodium Soundness  
Unit Weight  
Clay Lumps & Friable Particles  
Plasticity Index

C Gradation  
Stockpile Percentages  
Stockpile Specific Gravities & Absorptions  
Lime Specific Gravity & Percentage & Supplier  
Target Gradation  
Plotted Gradation (0.45 power curve, control points, caution zone)

C Gyratory Design  
Calibrated Gyratory Angle  
Calibrated Gyratory Pressure  
Specimen Heights

**Reported Elsewhere in the Submittal:**

C Trial Blend  
Plotted on 0.45 Power Curve (Control Points, Caution Zone)  
Stockpile Percentages  
Stockpile Bulk Specific Gravities  
Target Gradations  
%AC, %Gmm @ Nini, %Gmm @ Ndes, %Gmm @ Nmax (Sum. Table)  
%AC, % Air Voids, %VMA, %VFA, Dust/AsphaltBinder, %Gmm @ Nini,  
% Gmm @ Ndes, % Gmm @ Nmax (Summary Table @ Ndes)  
Trial Blends  
AC Percentage  
Compaction Results  
Nini - Ndes - Nmax  
Maximum Specific Gravity  
Gyratory Equipment Printouts for all Blends  
Specimen Heights  
Pressure Applied  
Gyrations Tables for Each Design AC Content  
Number of Gyrations  
Specimen Height  
Estimated Bulk Density  
Corrected Bulk Density  
% of Maximum Specific Gravity

**APPENDIX "B"**

**EXAMPLE OF UDOT'S MIX DESIGN REVIEW REPORT**

# Memorandum

## UTAH DEPARTMENT OF TRANSPORTATION

DATE:

TO:

Project Engineer

FROM:

Region Materials Engineer

SUBJECT: Superpave Level I Mix Design Review Report

Project No.:

Project Name:

Contractor:

The contractor has indicated that their source of aggregate, Size \_\_\_\_ will be the \_\_\_\_\_ and the brand of PG asphalt cement will be \_\_\_\_\_. The asphalt concrete pavement mix will be produced at the \_\_\_\_\_ plant. The following recommendations are based on tests of the aggregate and bituminous mix.

The optimum AC recommendation is based on the Gyratory Mix Design Method. **N<sub>initial</sub>** = \_\_, **N<sub>design</sub>** = \_\_, and **N<sub>max</sub>** = \_\_\_\_  
The field specimen compaction temperature is \_\_\_\_\_ and the combined specific gravity (G<sub>sb</sub>) of aggregates is \_\_\_\_\_. It is recommended that field Gyratory tests be done at production start, upon any mix adjustment, and at least once a week.

Asphalt Binder Grade: \_\_\_\_\_

Percentage Asphalt Binder: \_\_\_\_\_

Mixing Temperatures: \_\_\_\_\_

**Minimum** \_\_\_\_\_

**Maximum** \_\_\_\_\_

Minimum Compaction Temperature \_\_\_\_\_

### Stockpile Blends:

_____
_____
_____
_____

### CONTRACTOR'S DESIGN RESULTS:

Hydrated Lime % (Dry Wt. Agg.):

Job Mix Gradation

VMA:

Max. Specific Gravity (Rice):

Voids at N<sub>design</sub>:

Pavement Analyzer Results:

Burn-off Correction Factor:

Field:

Region:

Sieve

1 inch

3/4 inch

1/2 inch

3/8 inch

No. 4

No. 8

No. 16

No. 30

No. 50

No. 100

No. 200

% Passing

**Contractor's Superpave Mix Design Was: (See Box Checked Below)**

Verified As Submitted

Verified With Conditions

Not Verified for Following Reasons

9

9

9

Comments/Conditions/Reasons: \_\_\_\_\_